R E M A R K S

Reconsideration of the present application, as amended, is respectfully requested.

The July 31, 2002 Office Action and the Examiner's comments have been carefully considered. In response, the title, specification, abstract, drawings and claims are amended, claims are added, and remarks are set forth below in a sincere effort to place the present application in form for allowance. The amendments are supported by the application as originally filed. Therefore, no new matter is added.

Drawings

In the Office Action, the drawings are objected to because of certain formalities. Specifically, the Examiner states that there is no component "RG33" shown in Fig. 2 as taught on page 10 at lines 8 and 13. In response, the specification is amended to change reference designation "RG33" to --RG23--.

The Examiner also objects because in Fig. 1, boxes labeled "21" and "27" need to be labeled. In response, submitted herewith

are proposed amendments to Fig. 1 which include labels for boxes "21" and "27".

Submitted concomitantly herewith is a letter to the Official Draftsperson requesting approval of the proposed drawing changes to Fig. 1. Upon approval of the proposed drawing changes, a new formal drawing for Fig. 1 will be provided.

Abstract

In the Office Action, the Abstract of the Disclosure is objected to as including the phrase "for example". In response, the Abstract of the Disclosure is amended in a sincere effort to obviate the objection and to place the Abstract in better form. In view of the amendment of the Abstract of the Disclosure, reconsideration and withdrawal of the objection thereto are respectfully requested.

Specification

In the Office Action, the specification is objected to because of certain informalities pointed out by the Examiner on page 3 of the Office Action. In response, the specification is amended as requested by the Examiner. In view of the amendment of

the specification, reconsideration and withdrawal of the objection thereto are respectfully requested.

Title

The title of the invention is amended to be more clearly indicative of the invention to which the claims are directed.

Prior Art Rejections

In the Office Action claims 1, 3, 4, 6, 7, 8 and 12 are rejected under 35 USC 102(b) as being anticipated by USP 5,711,300 (Schneider et al). Claims 2 and 5 are rejected under 35 USC 103 as being unpatentable over Schneider et al. in view of USP 5,378,987 (Ishihara et al). Claims 9-11 are rejected under 35 USC 103 as being unpatentable over Schneider et al. in view of USP 5,938,599 (Rasche et al).

The present claimed invention is directed to a method and system which measures, on the basis of magnetic resonance signals, a temperature distribution in an object. Prior to the present invention, a problem occurred when patients moved during the acquisition of magnetic resonance signals. The prior art taught a cumbersome, time-consuming solution to the problem

wherein the execution of separate magnetic resonance excitation sequences for the detection of displacements of the object and for the measurement of the frequency shift due to variation of temperature (referred to as "chemical shift data") occurred. According to the prior art magnetic resonance imaging method, such magnetic excitation sequences must both be repeated for different values of the echo time in the measurement of the chemical shift.

The present claimed invention offers a simplified solution to account for disturbances which occur due to the motion of the object being examined.

The present claimed invention as defined by claim 1 is directed to a method of forming a magnetic resonance image of a region to be imaged which includes the steps of acquiring magnetic resonance signals, determining the position of a measuring site, and reconstructing the magnetic resonance image from the magnetic resonance signals and on the basis of the position of the measuring site.

In rejecting claim 1, the Examiner relies upon USP 5,711,300 (Schneider et al).

In the Office Action, the Examiner asserts that Schneider et al teaches at column 1, lines 24-27 that "the position of a measuring site is determined". Recognizing that this portion of Schneider et al do not state this limitation of claim 1, the Examiner further states that localization of the measurement signal data suggests that the location and/or position of the subject/object/target of the measurement site is determined because localization automatically restricts the imaging scan, to a specific, limited area. While Schneider et al may scan by a sequence of measurement cycles in which gradients vary according to particular localization methods being used, Schneider et al do not disclose, teach or suggest the step of determining the position of a measuring site as recited in claim 1. The present application teaches that in determining the position of a measuring site, the position can be separately measured and from this measurement a predetermined geometrical relationship exists between the measuring site and the region reproduced in the magnetic resonance image. This geometrical relationship is utilized such that if the patient being examined moves during the examination, the magnetic resonance imaging according to the invention insures that hardly any disturbances which are due to

such motions occur in the magnetic resonance image. Such a feature is not disclosed, taught or suggested in Schneider et al.

Specifically, the measuring magnetic resonance image is preferably made to register with the reference magnetic resonance image by counteracting disturbances due to motions during the formation of the measuring magnetic resonance image. Disturbances due to motion are counteracted according to the invention by insuring, on the basis of the position determined for the measuring site, that the reference magnetic resonance signals and the measuring magnetic resonance signals relate to or originate from the same region of the object to be examined. This can be readily achieved by selecting, on the basis of the measuring site, the same slice of the object for the acquisition of the reference magnetic resonance signals as well as for the acquisition of the measuring magnetic resonance signals. Thus, prior to the reconstruction of the reference magnetic resonance image and the measuring magnetic resonance image, it is already insured that the two magnetic resonance images concur.

The present application states that it has been found that a microcoil, introduced into the body of the patient, is particularly suitable for determining the position of the

measuring site. The microcoil receives magnetic resonance signals practically exclusively from the immediate vicinity of the microcoil. The magnetic resonance signals received by the microcoil thus accurately represent the current position of the microcoil. The location where the microcoil is situated thus constitutes the measuring site. No such specific determination of the measuring site is disclosed, taught or suggested in Schneider et al. nor does Schneider et al address the problems which are overcome by the present claimed invention.

The other references of record do not close the gap between the present claimed invention as defined by claims 1, 6, 10 and 12 and Schneider et al.

In view of the foregoing claim 1 is patentable over Schneider et al under 35 USC 102 as well as 35 USC 103. Claims 6, 10 and 12 include the limitation or variation thereof present in claim 1 of "determining the position of a measuring site". Therefore, claims 6, 10 and 12 are patentable over the cited references under 35 USC 102 as well as 35 USC 103.

Dependent claims 2-5, 7-9 and 11 are either directly or indirectly dependent on claims 1, 6, 10 and 12. These claims are separately patentable over the cited references and in view of

their dependence on one of the independent claims. In view of the foregoing, claims 1-12 are patentable over the cited references under 35 USC 102 as well as 35 USC 103.

New claims

New claims 13-17 are added to the present application. Claim 13 corresponds to claim 9, but is dependent on claim 6. Claims 14-17 further define and limit the inventions defined by claims 1, 6, 10 and 12 respectively. Claims 14-17 are separately patentable over the cited references and they are patentable in view of their dependence on the independent claims.

It is respectfully believed that no additional fees are due for the presentation of claims 13-17. However, if any additional fees are due, please charge Deposit Account No. 14-1270 for such sum.

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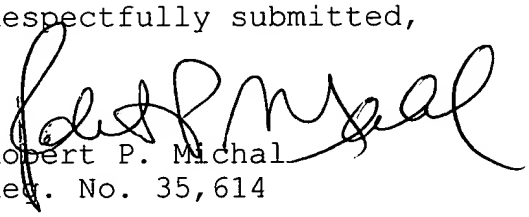
If the Examiner disagrees with any of the foregoing, the Examiner is respectfully requested to point out where there is support for a contrary view.

Entry of the amendment, allowance of the claims, and the passing of the application to issue are respectfully solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,



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Enclosures:
(1) Copy of abstract amendments showing changes made thereto
(2) Copy of specification amendments showing changes made thereto
(3) Copy of claim amendments showing changes made thereto

COPY OF CLAIM AMENDMENTS SHOWING CHANGES MADE THERETO
SERIAL NO. 09/857,310

1. (Amended) A method of forming a magnetic resonance image of a region to be imaged [wherein] comprising the steps of:

[-] acquiring magnetic resonance signals [are acquired],

[-] determining the position of a measuring site [is determined], and

[-] reconstructing the magnetic resonance image [is reconstructed] from the magnetic resonance signals and on the basis of the position of the measuring site.

2. (Amended) A method of forming a magnetic resonance image as claimed in Claim 1 [wherein] further comprising the steps of:

[-] reproducing a detail and an indication of the measuring site [are reproduced], and

[-] correcting the position of the detail in the magnetic resonance image [is corrected] on the basis of the position of the indication of the measuring site in the magnetic resonance image.

3. (Amended) A method of forming a magnetic resonance image as claimed in Claim 1 [wherein] further comprising the steps of:

[-] acquiring a set of measuring magnetic resonance signals [is acquired] at a reference temperature,

[-] acquiring a set of measuring magnetic resonance signals [is acquired] after the temperature has been changed, notably increased, at the area of the measuring site,

[-] deriving a reference magnetic resonance image [is derived] from the reference magnetic resonance signals,

[-] deriving a measuring magnetic resonance image [is derived] from the measuring magnetic resonance signals, and

[-] making the measuring magnetic resonance image and the reference magnetic resonance image [are made] to register on the basis of the position determined for the measuring site.

4. (Amended) A method of forming a magnetic resonance image as claimed in Claim 3 [wherein] further comprising the step of:

[-] on the basis of the position determined for the measuring site acquiring the reference magnetic resonance signals and the measuring magnetic resonance signals [are acquired] from essentially the same region.

5. (Amended) A method of forming a magnetic resonance image as claimed in Claim 3 [wherein] further comprising the steps of:

[-] reproducing a detail and an indication of the measuring site [are reproduced] in the reference magnetic resonance image,

[-] reproducing the same detail and the indication of the measuring site [are reproduced] in the measuring magnetic resonance image, and wherein

[-] a shift of the detail is derived from respective positions of the detail relative to the indication of the measuring site in the reference magnetic resonance image and the measuring magnetic resonance image, [-] correcting the position of the detail in the measuring magnetic resonance image [is corrected] on the basis of the derived shift of the detail.

6. (Amended) A method of forming a magnetic resonance image of a region to be imaged [wherein] comprising the steps of:

[-] acquiring magnetic resonance signals [are acquired],

[-] measuring the position of a measuring site [is measured], and

[-] deriving the temperature at the measuring site [is derived] from the magnetic resonance signals.

7. (Amended) A method of forming a magnetic resonance image as claimed in Claim 6 [wherein] further comprising the steps of:

[-] acquiring a set of reference magnetic resonance signals [is acquired] at a reference temperature,

[-] changing the temperature at the area of the measuring site [is changed] relative to the reference temperature, the temperature notably being increased at the area of the measuring site,

[-] subsequently acquiring a set of measuring magnetic resonance signals [is subsequently acquired], and

[-] deriving a temperature distribution [is derived] from the reference magnetic resonance signals, the position of the measuring site and the measuring magnetic resonance signals.

8. (Amended) A method of forming a magnetic resonance image as claimed in Claim 7 [wherein] further comprising the step of:

[-] deriving a thermal image [is derived] from the measuring magnetic resonance signals, the reference magnetic resonance signals and the position of the measuring site, said thermal image reproducing the temperature distribution.

9. (Amended) A method as claimed in Claim 1 [or 6] wherein

[-] a microcoil is used to acquire position magnetic resonance signals at the area of the microcoil, and

[-] the position of the measuring site is derived from the position magnetic resonance signals.

10. (Amended) A magnetic resonance imaging system for forming a magnetic resonance image of a region to be imaged [provided with] comprising:

[-] a coil system for acquiring magnetic resonance signals and for determining the position of a measuring site, and

[-] a reconstruction unit for the reconstruction of [a] the magnetic resonance image from the magnetic resonance imaging signals and the position determined for the measuring site.

11. (Amended) A magnetic resonance imaging system as claimed in Claim 10 [which includes] further comprising:

[-] a microcoil for the acquisition of position magnetic resonance signals at the area of the microcoil, and wherein

[-] the reconstruction unit is arranged to derive the magnetic resonance image from the magnetic resonance signals and on the basis of the position magnetic resonance signals.

12. (Amended) A computer program which forms a magnetic resonance image of a region to be imaged containing instructions for:

[-] the acquisition of magnetic resonance signals, and

[-] the determination of the position of a measuring site, and

[-] the reconstruction of a magnetic resonance image from the magnetic resonance imaging signals and the position determined for the measuring site.